Technology Paradigm Shifts
Commercial Survival Lessons

D.H. BROWN
ASSOCIATES, INC.

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Abstract

Subject Terms

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unclassified	unclassified

Classification of Abstract	Limitation of Abstract
unclassified	UU

Number of Pages
18
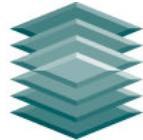
Drivers in Discrete Manufacturing

❖ **Paradigm Shift? 3 to 5 years out**

❖ **Disruptive Technology: Biggest Challenge, Risk - Organizational**

❖ **Modular design**

❖ **Simulation's & Physical Testing**

  - *CAE Data Management/Infrastructure*

  - *MDO Multi-Disciplinary Optimization, Multi-physics*

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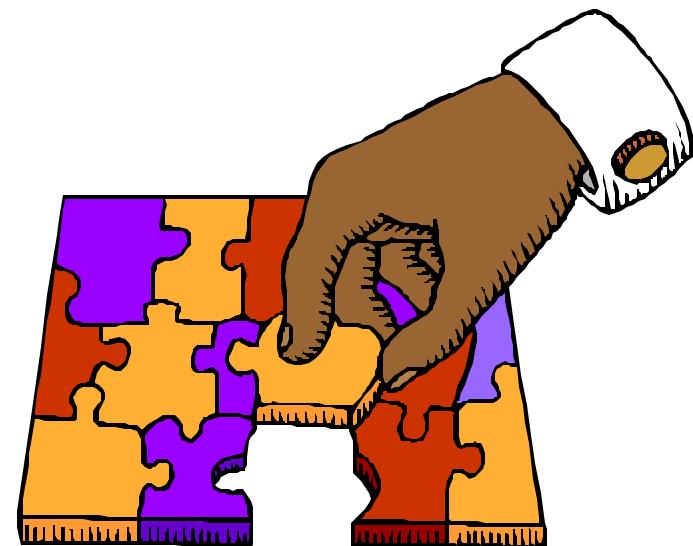
Dramatic Impact

❖ **Up Front Design/or Front End Loading**

  - *Redefine Skill Sets, Training Roles, Performance Metrics*

❖ **Standardization: Design & Manufacturing**

❖ **Knowledge Management**

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Collaborative Research Program:
Focusing on Designers
dhbrown@dhbrown.com
for outline & proposal*

Project Engineering

CAE

Design and Test

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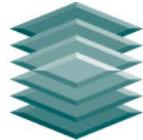
Outline

❖ **Paradigm Shift?** *Don Brown, DHBA*

❖ **Up Front Design/or Front End Loading** *Don summarizes for Greg Roth, Eaton, Jeff Okrutny, Delphi Automotive Systems*

❖ **Simulation & Physical Testing** *Jim Crosheck, Deere & Company*

❖ **CAE Data Management/Infrastructure** *Keith Meintjes, General Motors Corporation*

❖ **Standardization** *Keith*

❖ **Modular Design** **Jim, Keith & Don,**

❖ **Knowledge Management**

❖ **MDO Multi-Disciplinary Optimization, Multi-physics**
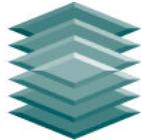
Relevance to you and DoD?

❖ **Lessons of Paradigm Shifts**

❖ **SBA Involves a Paradigm Shift**

"Dramatic reductions in complex system acquisition life cycle cost and development schedule cannot be achieved via *incremental systems engineering process and method improvements*. A bold innovative shift is required… The consequences of not achieving a successful systems acquisition *paradigm shift* which can avert the downward spiral of cost overruns and failures are severe and will be amplified as the complexity and magnitude of future systems continues to rise…"

The Simulation Based Acquisition Vision

Nicholas Karangelen, nkarang@tridsys.com

Trident SkyIstems Inc., undated

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Tumultuous

❖ **Primary Characteristic?**

❖ **Continuous Wave of Change**
   … *Disruptive Technology*

The Innovators's Dilemna,
When New Technologies Cause Great Firms to Fail, C.M. Christensen, 1997.

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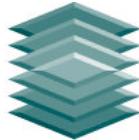
$200 Billion…
IBM… Intel… Microsoft…
Compaq… Dell
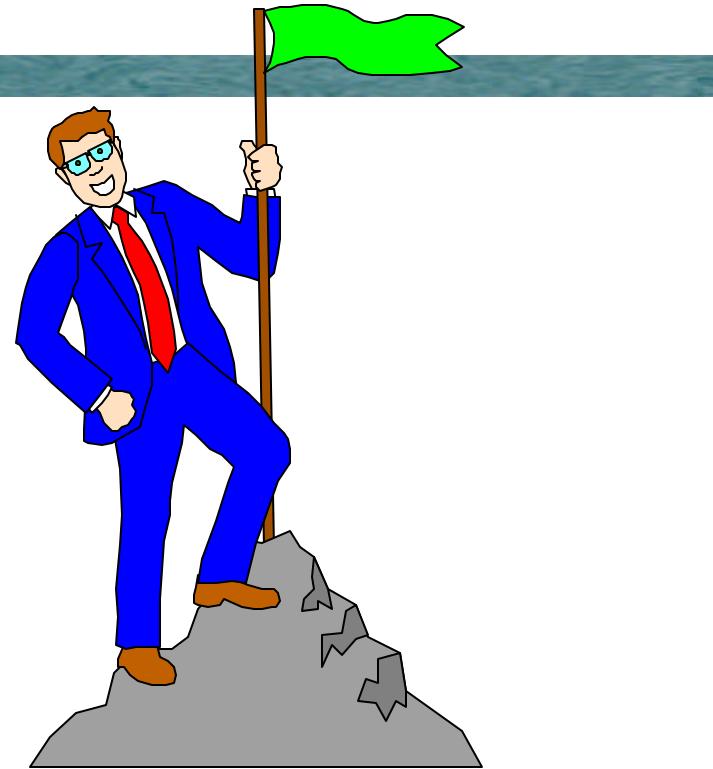
Seven Dwarves?
Burroughs…Univac… Control Data…
GE… RCA… and who?

Minicomputers?
DEC… Data General… Prime Computer…
Wang Labs… Apollo

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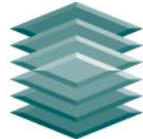
Cumulative Impact of Compounding

Change Over 10 Years

|				
15%	**30%**	**45%**	**59%**	**112%**
4.0X's	**13.8X's**	**41.1X's**	**101.6X's**	**1845.2X's**
`69-`83	**`83-`97**	**`83-`97**	**Moore's**	**Q1/95-**
minis	**min**	**possible**	**Law**	**Q1/97**
				tpmC

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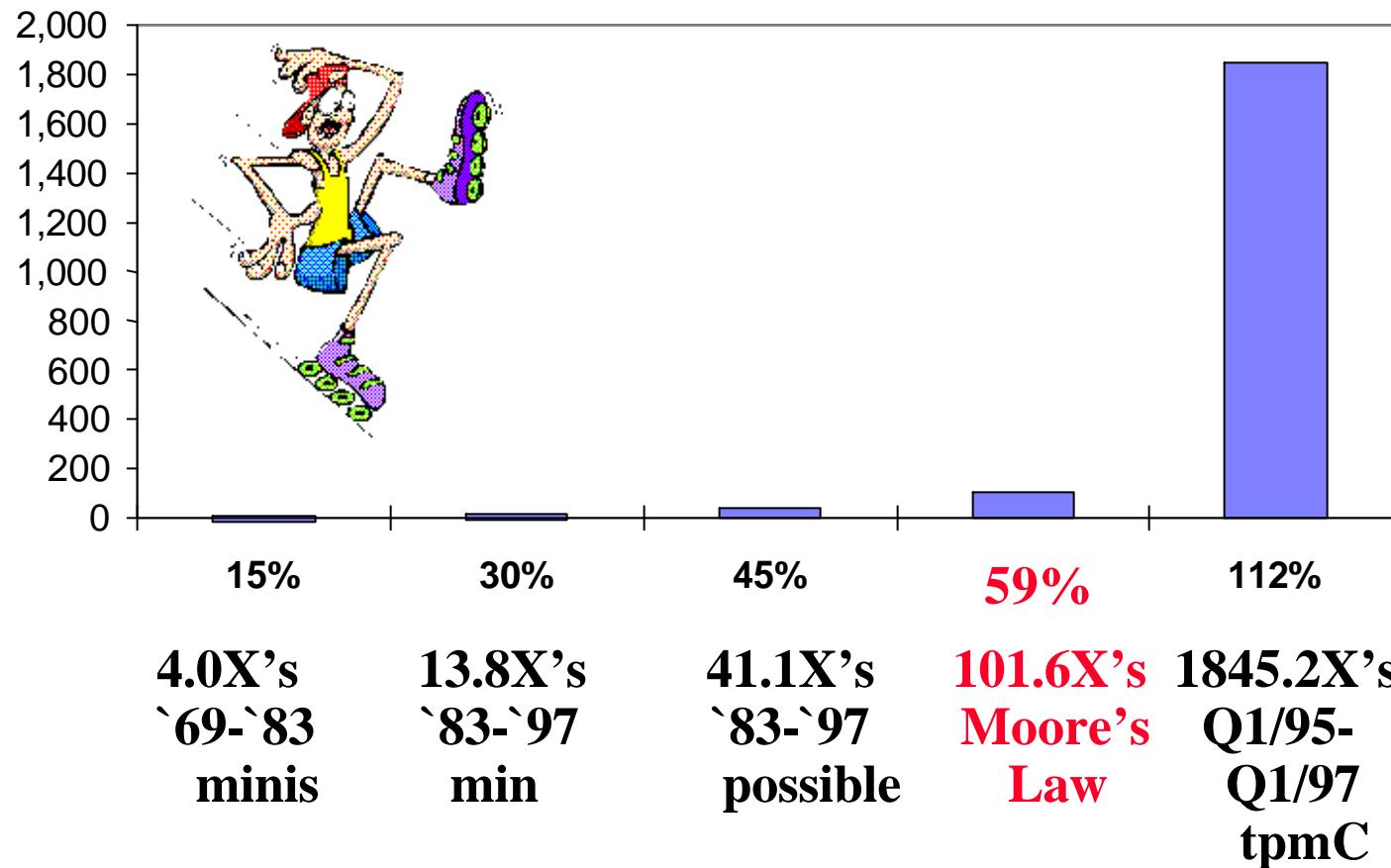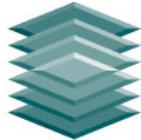
What are those lessons?

❖ **Risk: Local optimization**

❖ **Driver: Modularization of Design Critical**

❖ **Driver: Simulation and Test Critical**
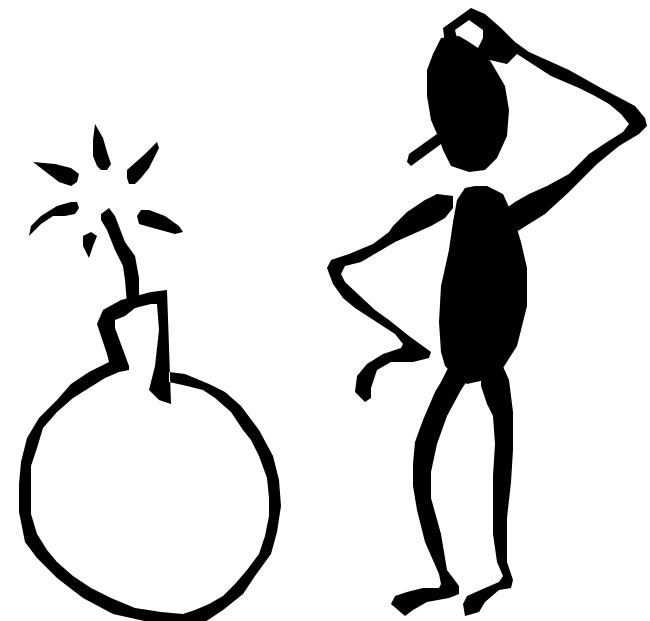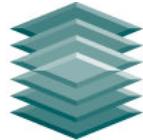
Local Optimization

❖ **No Guarantees**

- *Past success*

- *Size*

❖ **Limited Predictability
Random Chance Greater Than Most Like to Admit**

❖ **Getting Real Recognition,
Understanding Tough, Action?**

- *The Art of the Long View,*
Peter Schwartz

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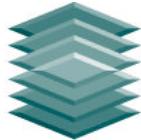
Recommendations

❖ **#1: Get Change Agents**

- *Skunkworks, Venture Capitalists*

- *Established Leaders May not Lead the Breakout*

- *IBM brought in an outsider… Boeing moves it's HQ*

❖ **#2: Monitor Closely**

- *Driver: Modularization of Design Critical*

- *Driver: Simulation and Test Critical*

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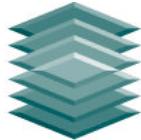
Push, and Measure Progress in:

❖ **Modular Design**

❖ **Simulation & Physical Testing**

❖ **CAE Data Management/Infrastructure**

❖ **MDO Multi-Disciplinary Optimization, Multi-physics**

❖ **Up Front Design/or Front End Loading**

❖ **Standardization**

❖ **Knowledge Management**

❖ **Objective: Stay One Jump Ahead of the Next Guy**

      - *Not Optimization, Not "Best Practices"*

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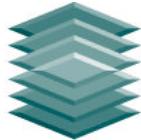
Principles of Modular Design - Computer Systems

❖ **Create Nested, Regular, Hierarchical Structures In a Complex System**

  - *Design Rules Critical! Design Rules of System/360 - the first standards battle in the computer industry*

❖ **Define Independent Components Within an Integrated Architecture**

  - *Decentralization of Control, Continuous Innovation at Module Level*

  - *Multiplies Options at Module Level*

❖ **Establish and Maintain Rigorous Partitions of Design Information into Hidden and Visible Subsets**

❖ **Invest in Clean Interfaces and "Good" Module Tests**

  - *Design evolution can only proceed as fast as good simulation and testing enhances confidence, and insures quality*

Design Rules
Volume 1 The Power of Modularity
Carliss Y. Baldwin & Kim B. Clark
MIT Press, 2000

Up Front Design/or Front End Loading

❖ **Optimization Engine/Design Discovery**

- *Driven by WEB, Accelerated Innovation*

- *Hundreds of simulations - search all design alternatives*

❖ **Design Criteria Entire Product Life,**

- *Warranty costs, even maintenance schedules*

❖ **Templates of well-defined, well understood frequently repeated analyses**

- *Automated model creation and knowledge-based data interpretation*

❖ **Monitored and managed by CAE experts**
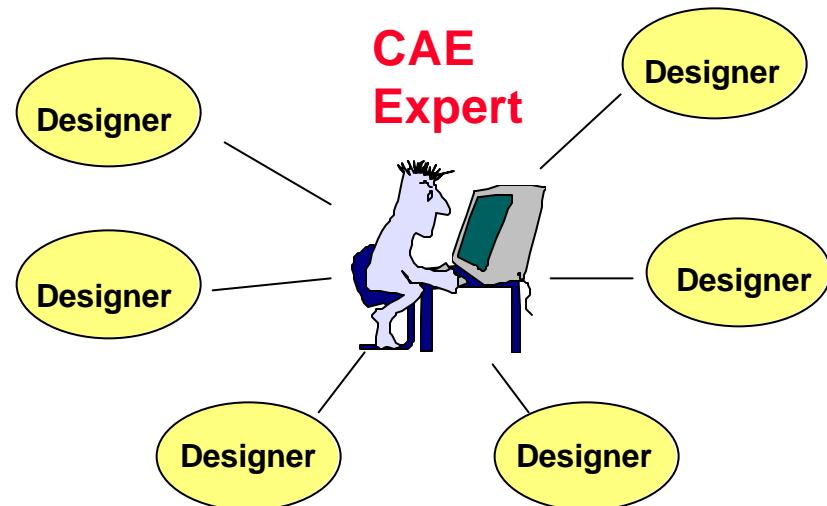
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Achieving Economy of Scale for CAE in the Design Process

Product Designs

Product Designs

Product Designs

Product Designs

Basic CAE Analysis Done By Engineers and Designers

Basic CAE Analysis Check Point

CAE Monitoring Process
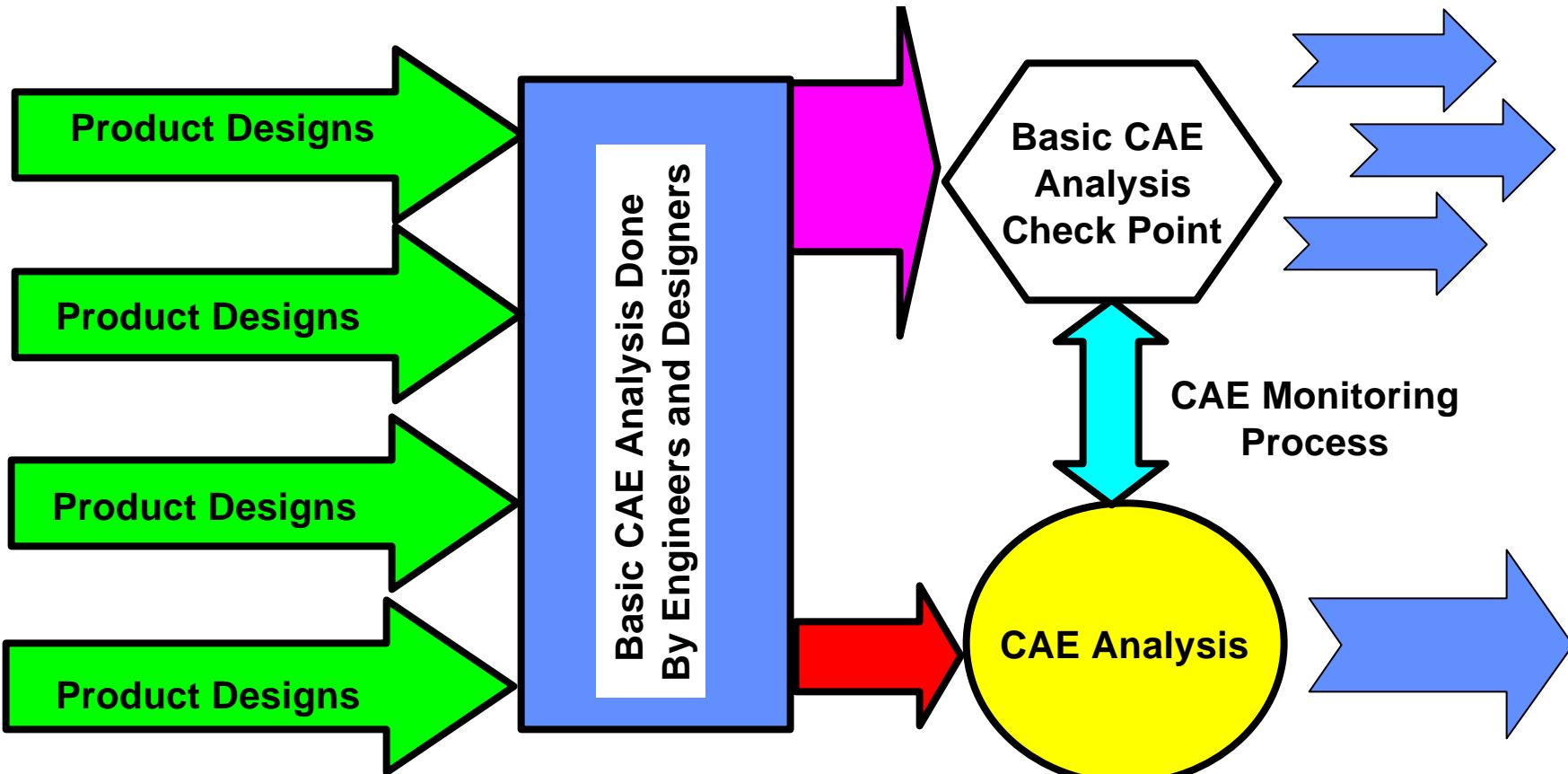
CAE Analysis

Gregory Roth - Eaton Corporation
http://www.ANSYS.com/action/white_papers/early_analysis.htm
paul.bemis@ansys.com

EAT•N
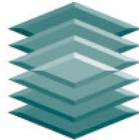
Paradigm Shift?

❖ **Redefine Skill Sets**

❖ **Redefine Roles**

❖ **Redefine Performance Metrics**

Project Engineering

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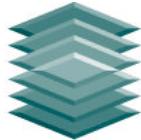
Background: Point of View

❖ **Since 1969 – Computer Systems/Software**

❖ **Since '84 : D. H. Brown Associates:**

- *Collaborative Research Subscription Programs*

- *Software & Systems: Requirements Analysis,*

- *Discrete Manufacturing: Software & Systems, Process, Business Metrics*
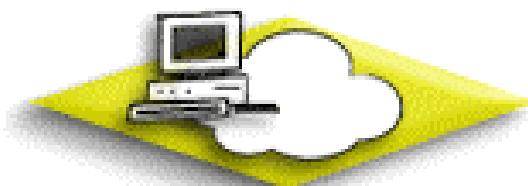
Open Systems
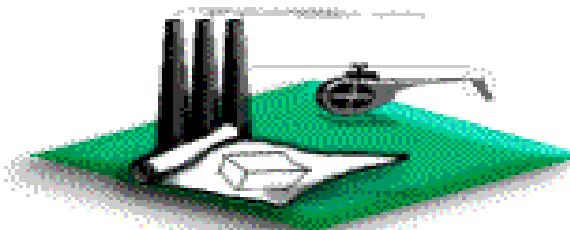
Eng. Mfg. Design
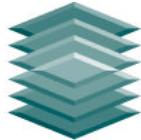
❖ **Jim Crosheck, Sr. Staff Engineer, Deere & Company**

- *selection of electronic tools the product development process*

- *leading the analytic support of the integrated test and analysis*

- *re-joined Deere & Company in 1999 after spending 11 years as Vice-President, Engineering Services, at CADSI, now LMS/CADSI, where he led their consulting activity in multibody dynamics applications.*

- *Prior to CADSI, Jim spent 15 years at the Deere & Company*

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